

# Chromalox®

## Installation, Operation and RENEWAL PARTS IDENTIFICATION

### SERVICE REFERENCE

DIV. 4	SEC. BCT	NUMBER 3001
SALES REFERENCE		PK451
161-058028-001		
DATE	DECEMBER, 1986	

## Chromalox Indicating Thermostat Control — Model BCT

Model Numbers are listed below

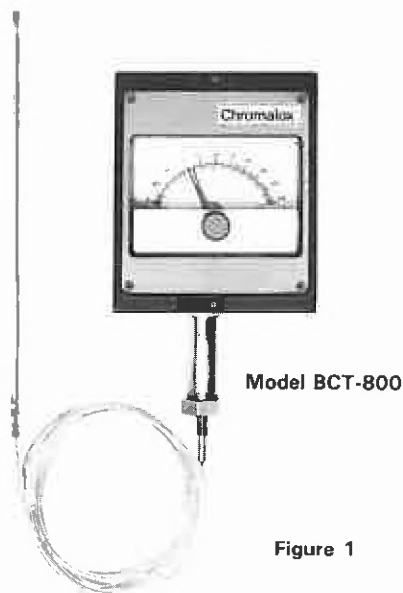


Figure 1



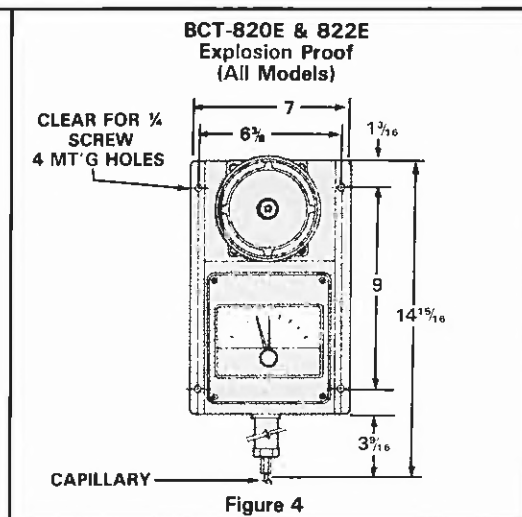
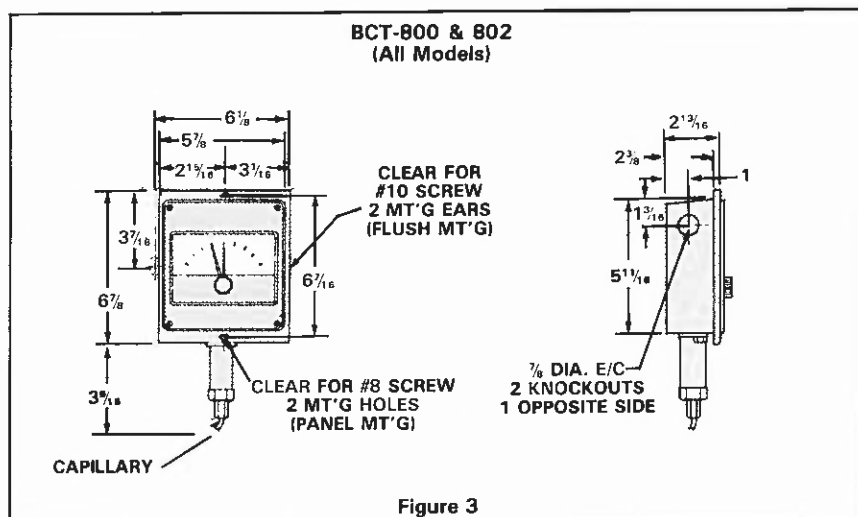
Figure 2

Specifications — Table A

Dual Temp. Range	Model Number	Bulb and Cap Material	Cap Length (FT)	Thermal Element Bulb (IN)	
				Dia.	Length
- 40° to 120°F - 40° to 50°C	BCT-800-4BC BCT-802-4BC*	Copper	6	3/8	6 1/2
	BCT-800-4BS BCT-802-4BS*	Stainless Steel	6	3/8	6 1/2
0°F to 250°F - 20° to 120°C	BCT-800-6BC BCT-802-6BC*	Copper	6	3/8	4 1/8
	BCT-800-6BS BCT-802-6BS*	Stainless Steel	6	3/8	4 1/8
	BCT-800-6BS-TEF BCT-802-6BS-TEF*	Teflon Covered Stainless Steel	10	3/8	4 1/8
	BCT-800-7BS BCT-802-7BS*	Stainless Steel	6	3/8	2 1/4
0° to 400°F 10° to 340°C	BCT-800-8BS BCT-802-8BS*	Stainless Steel	6	3/8	3
50° to 1000°F 10° to 540°C	BCT-800-9BS BCT-802-9BS*	Stainless Steel	6	3/8	4 1/8
Explosion Proof Models					
- 40° to 120°F - 40° to 50°C	BCT-820E-4BC BCT-822E-4BC*	Copper	6	3/8	6 1/2
	BCT-820E-4BS BCT-822E-4BS*	Stainless Steel	6	3/8	6 1/2
0°F to 250°F - 20°F to 120°C	BCT-820E-6BC BCT-822E-6BC*	Copper	6	3/8	4 1/8
	BCT-820E-6BS BCT-822E-6BS*	Stainless Steel	6	3/8	4 1/8
	BCT-820E-6BS-TEF BCT-822E-6BS-TEF*	Teflon Covered Stainless Steel	10	3/8	4 1/8
	BCT-820E-7BS BCT-822E-7BS*	Stainless Steel	6	3/8	2 1/4
50 to 650°F 10° to 340°C	BCT-820E-8BS BCT-822E-8BS*	Stainless Steel	6	3/8	3
50 to 1000°F 10° to 540°C	BCT-820E-9BS BCT-822E-9BS*	Stainless Steel	6	3/8	4 1/8

\* Dual Switch Models

## DIMENSIONS



## GENERAL

**CAUTION:** Models BCT-800 and 802 are not for use in hazardous environments as described in National Electrical Code. Failure to comply can result in explosion or fire.

**NOTICE:** Type BCT controls are designed for temperature control service only. Because they do not fail safe, they should not be used for temperature limiting duty.

**CAUTION:** Users should install adequate controls and safety devices with their electric heating equipment. Where consequences of failure may be severe, back-up controls are essential. Although the safety of the installation is the responsibility of the user, Chromalox will be glad to make equipment recommendations.

Model BCT is an indicating temperature controller designed to control heating and/or cooling systems. They are supplied with either one or two 3-wire, single-pole, double-throw switch(es) of the snap-acting type. The control is actuated by an oil filled thermal-sensing element except for 9BS models which are mercury filled. All are field replaceable and interchangeable with other elements of the same range as indicated in Table A.

**NOTE:** It is **not** recommended to switch systems directly from heating to cooling and vice versa.

**Power Supply — WARNING:** Use on AC only. Thermostat is not DC rated.

**Packing Glands —** If a sealed or leak-proof connection is required at the point where the capillary enters the oven, tank, pipe or similar equipment, an appropriate packing gland is available as an optional part. (Catalog Numbers V42-25A, V42-25D or V42-25E)

**Principle of Operations —** Temperature variations are sensed by the liquid-filled bulb which hydraulically transmits motion through a bellows to a rack-pinion mechanism which rotates the indicating pointer and actuates the precision snap-acting switch(es). Controller settings are made by turning the adjustment knobs causing the cams to reposition the precision snap switch(es) in relation to the thermal sensing system.

**Process Temperature Differential —** is variation in controlled process temperature between maximum, when thermostat turns OFF and minimum, when thermostat turns ON. This spread in temperature may be minimized by —

1. Avoiding excess heating capacity (oversized heaters).
2. Locating control sensing bulb in optimum position between heat source and work.

In general, it is difficult to predict the actual operating differential of a given process. Temperature differential may be as low as 2°F for low range controls to as high as 10°F for higher range controls since the differential is a percentage function of the dial range.

**Specification — Table B**

Storage Temperature: Ambient Temperature Limits:	— 65 to + 160°F. — 40 to + 160°F. Set point typically shifts less than 1% of range for a 50°F (28°C) ambient temperature change.	Electrical Rating: Enclosure: BCT-800, 802, BCT-820E, 822E Explosion proof)	15 amp 125/250/480 VAC resistive Lexan, black finish. Die cast aluminum (max 0.4% copper), light grey aluminum lacquer finish, gasketed. Clear Lexan®
Shock:	Set point repeats after 15 G, 10 millisecond duration.	Faceplate: Weight: BCT-800, 802 BCT-820E, 822E Explosion proof)	
Vibration:	Set point repeats after 2.5 G, 5-500 CPS.	Electrical Connection: BCT-800, 802 Wiring (800, 802)	Approx. 3 lbs. 4 oz. Approx. 7 lbs.
Enclosure Classification: BCT-800, 802, BCT-820E, 822E Explosion Proof)	NEMA 1, NEMA 4, 7, 9	BCT-820E, 822E Explosion proof)	(2) 3/8" diameter knockouts. #18 AWG color coded leadwires, approx. 9" exposed with strain relief. 3/4" NPT right hand side, Terminal block standard.
Set Point Repeatability: Indication Accuracy: Switch Output:	± 1% of adjustable range ± 1% of adjustable range (1) or (2) SPDT. Dual switch may be separated up to 100% of range.	Temperature Deadband:	Typically 1% of range under laboratory conditions, (70°F ambient, circulating bath at rate of 1/2 °F per minute change).
Dual Switch Adjustment:	Dual switch controls standardly have separate knob & temperature pointers for each switch. Turn inner knob for setting #1 switch and outer knob for #2 switch.		

## MOUNTING

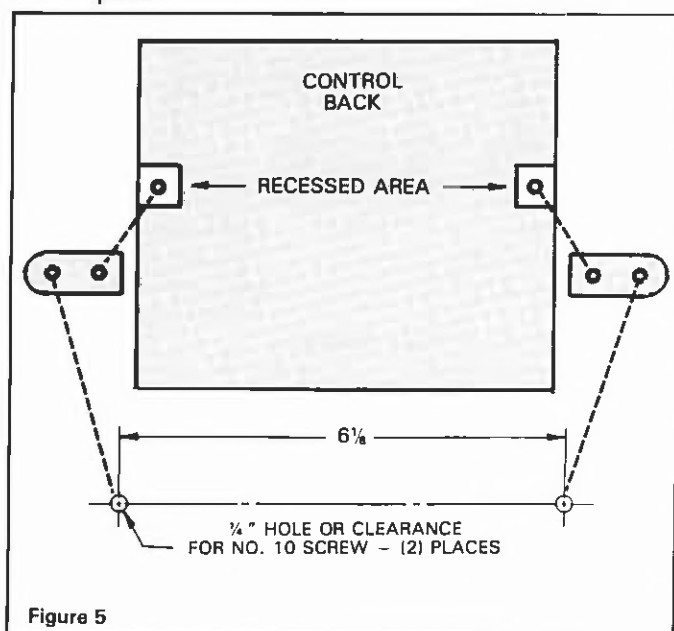
**NOTE:** Do not mount control where it will be subject to vibration, shock, grease, dust, lint or corrosive vapors. Do not mount adjacent to a large magnetic contactor, as vibration and shock will cause thermostat to interact erratically — resulting in chattering of the contactor.

The air temperature in and around the control enclosure should be kept as near to normal room temperature as possible...**never** above 160°F nor below -40°F.

1. Remove adjustment knobs and cover.
2. Knockout Electrical Entrance — Two cast-in knockouts for ½" conduit are located in the sides of the enclosure. Either can be easily knocked out with a screwdriver by placing its blade in the groove and rapping its end sharply with a hammer.
3. The BCT-800 or 802 can be either surface or flush mounted. BCT-820E or 822E can only be surface mounted.

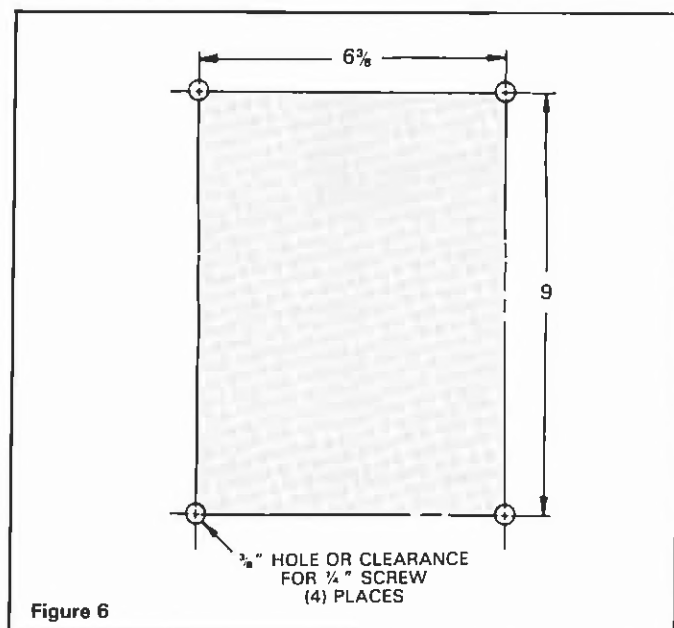
### A. Surface mounting —

1. BCT-800 or 802 model (See Figure 5). Attach the two (2) mounting tabs found in separate package to recessed areas on back side of enclosure using the two (2) self-tapping flat head screws. Using two (2) #10 screws with nuts, mount the control to the surface or panel.



**Figure 5**

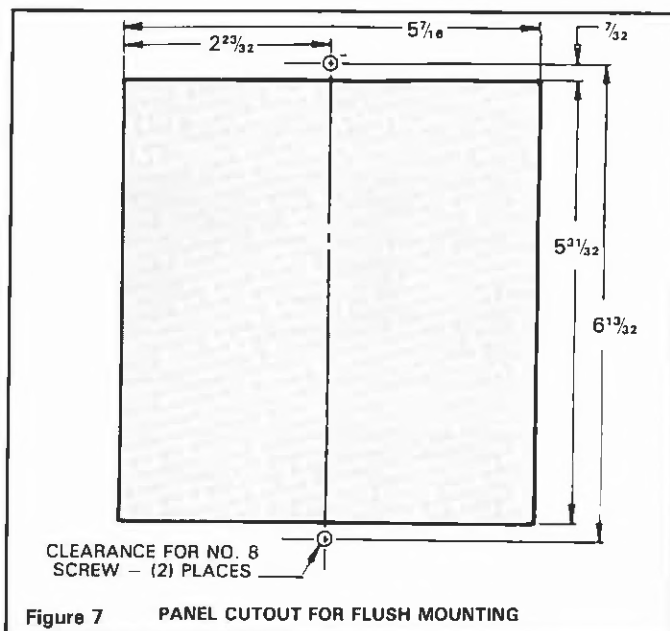
2. BCT-820E or 822E (See Figure 6). Using four (4) 1/4" screws with nuts, mount the control to the surface or panel (BCT-822E models require a seal fitting, install the nipple and sealing fitting prior to surface mounting the control).



**Figure 6**

### B. Flush Mounting

1. The controller may be mounted in any position to a flat surface or panel (1/4" thick maximum).
2. Cut out the panel as shown in Figure 7. Mount to the panel using the 2 holes located on the flange of the enclosure.



**Figure 7** PANEL CUTOUT FOR FLUSH MOUNTING

### C. Bulb and Capillary Mounting

1. Fully immerse the bulb and 6" of capillary in the control zone. For best control it is generally desirable to place the bulb close to the heating or cooling source in order to sense temperature fluctuations quickly. Be sure to locate the bulb so it will not be exposed to temperatures beyond the instrument range limits.

2. Place the remaining capillary adjacent to the control head so that it will sense the same ambient temperature.

3. Factory calibration, unless specified otherwise, allows for 6" capillary tube in the control zone. If longer lengths are required recalibration may be necessary, in which case follow the procedures outlined in **CALIBRATION**.

4. Avoid bending or coiling the capillary tube tighter than  $\frac{1}{2}$ " radius. Exercise caution when making bends near the capillary ends.

**NOTE:** If material in contact with bulb or capillary is corrosive, a protective well should be used. Protective wells are available at extra cost. Check factory.

**NOTICE: —**

- A. Bending or deforming sensing bulb will alter control calibration.  
B. Do not kink capillary tube. The resulting constrictions in fluid flow can destroy control function or broaden temperature differential. Minimum capillary tube bending diameter is 1" I.D. (See Figure 8)



**Figure 8  
(Capillary Tube)**

- C. Any deformations of bulb or capillary that result in leakage of fluid from control renders control inoperative.
- D. Avoid passing control capillary tube through zones whose temperature is in excess of controlled process temperature. Erratic control or destruction of control function may result.

## WIRING

**CAUTION: Hazard of electrical shock. Disconnect all power before wiring or servicing this control. Failure to comply can result in electrical shock or electrocution.**

1. Electric wiring must be installed in accordance with the National Electrical Code and with local codes. **WARNING:** Use copper conductors only.

2. BCT-800 and 802 models:

A. Connect the electrical conduit to the case securing it with a locknut.

B. Wire through the knockout directly to the leadwires provided, color coded as follows:

	Switch 1	Switch 2 (BCT-802 Model Only)
Common	Violet	Yellow
Normally Open	Blue	Orange
Normally Closed	Black	Red

See Figures 9 and 10.

**NOTE:** Dual Switch BCT-802 models, the #1 switch set point may not be set higher than that of the #2 switch.

C. The normally-closed contacts will open on temperature rise and are used on heating applications.

D. The normally-open contacts will close on temperature rise and are used on cooling applications.

**NOTE:** Electrical connections should be made with generous loops of wire — approximately 6" per lead.

3. BCT-820E and 822E

A. Wiring to control housing must be in rigid conduit also in accordance with National Electrical Codes (NEC) for hazardous locations.

B. Connect the rigid conduit directly to the die cast aluminum enclosure.

C. Wire directly to the switch (single switch Figure 11) or to the terminal block (dual switch — Figure 12).

4. **NOTE:** If load amperage or voltage rating exceeds switch rating, a contactor must be used. (See Figures 13 and 14). Contactor and wiring to be supplied by customer.

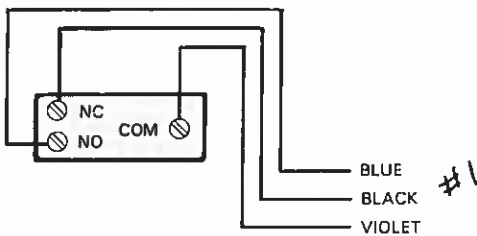


Figure 9

SINGLE SWITCH

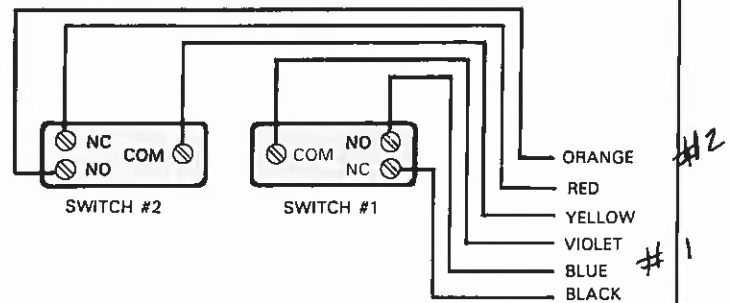


Figure 10

DUAL SWITCH

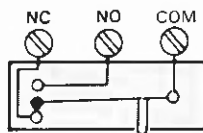


Figure 11

SINGLE SWITCH

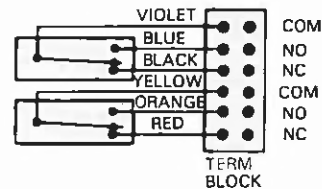
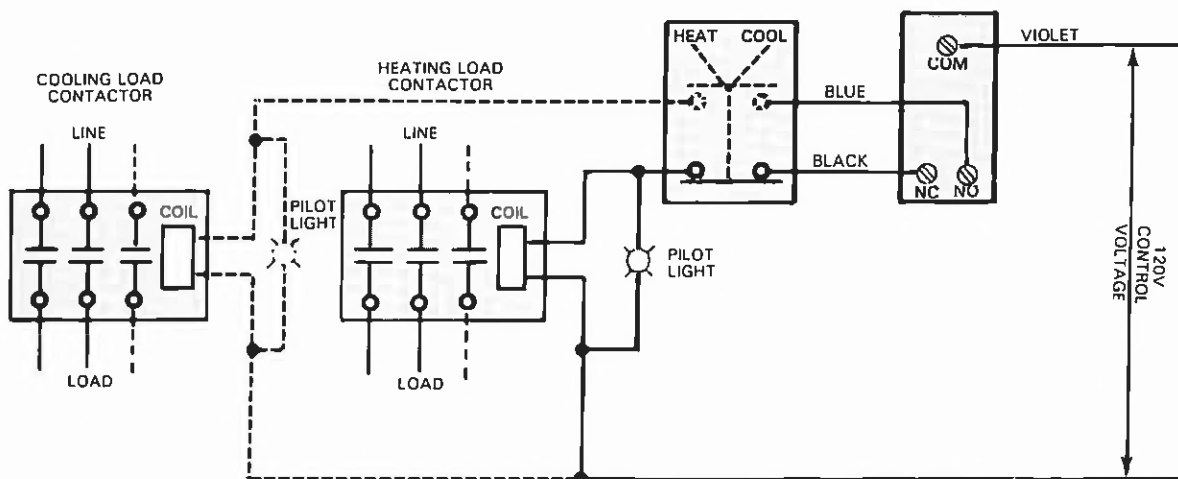


Figure 12

DUAL SWITCH



SINGLE SWITCH

Figure 13

## WIRING

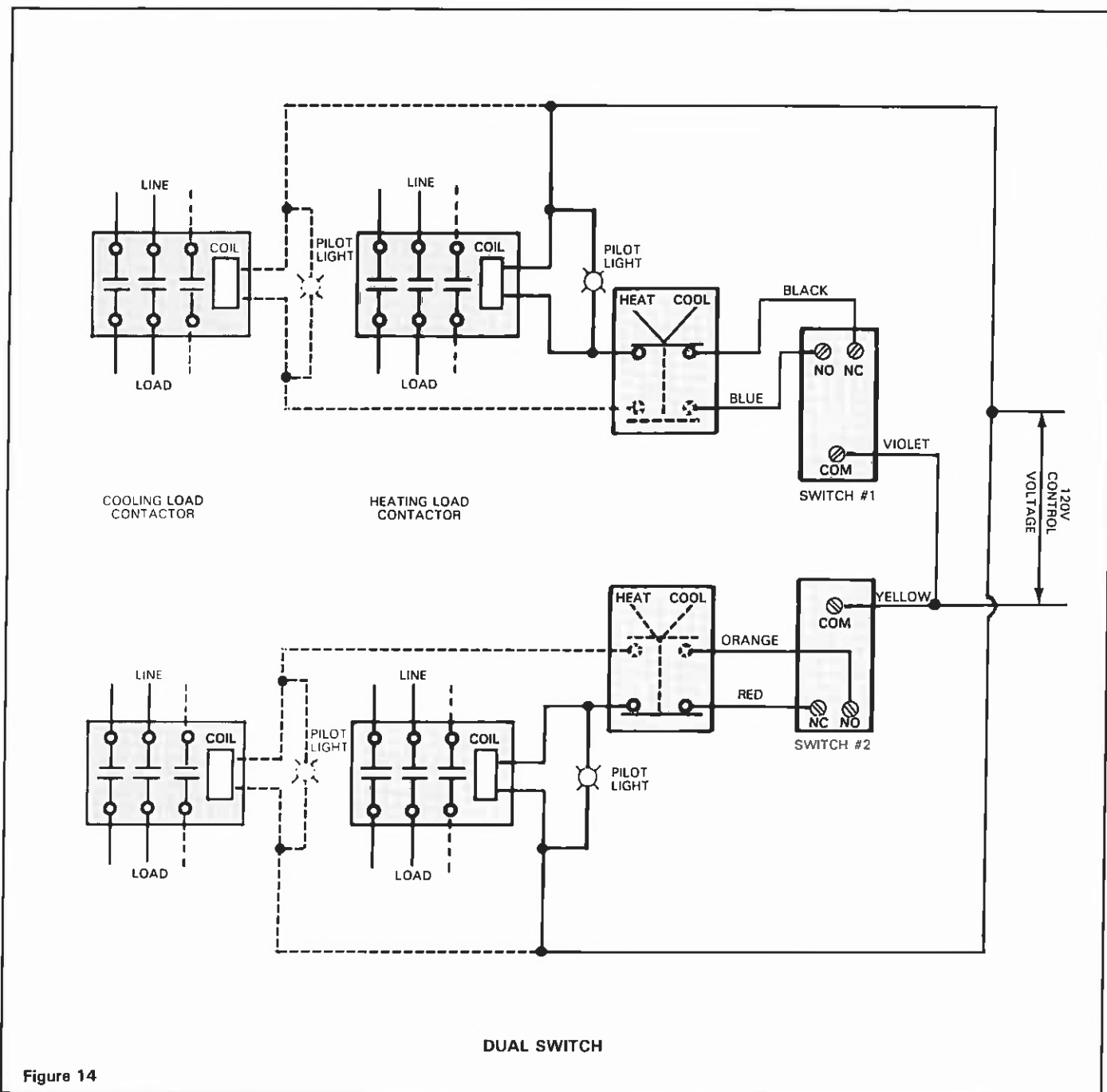


Figure 14

## CALIBRATION

**CAUTION: Hazard of electric shock. Extreme care should be exercised during calibration adjustments because of shock hazard due to exposed electrical terminals.**

These controls are factory calibrated to the range indicated on the dial scale of the control.

If calibration is required either one of two methods may be followed.

1. If accurate measurement standards are not available, the thermostat can be adjusted readily to a known temperature standard such as boiling water (212°F). (See Figure 15).

2. With the aid of an accurate thermometer or other temperature measuring device, recalibration may be performed within the process as in Figure 16.

A. Make certain process temperature is stabilized. After allowing adequate time for temperature to stabilize, compare test thermometer reading with reading of black indicating pointer.

B. If the two readings do not agree, instrument should be re-zeroed.

For either method the following general "re-zeroing" procedures should be followed.

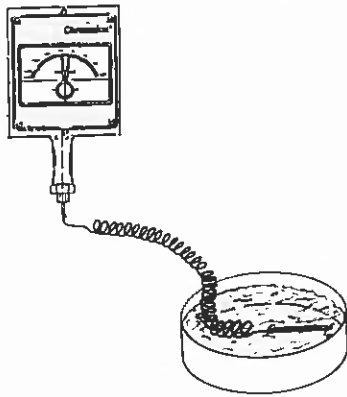


Figure 15

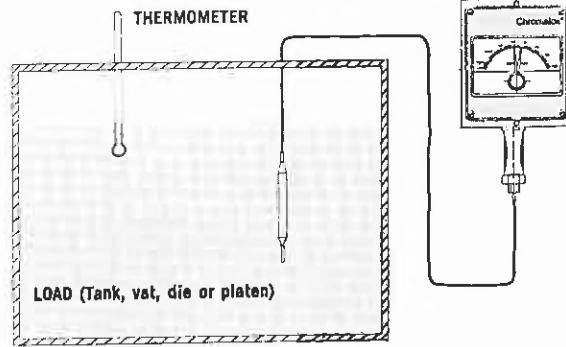


Figure 16

### RE-ZEROING

1. Be certain process or known temperature is stabilized.
2. Move red set pointer of BCT to temperature indicated by test thermometer or to the known temperature.
3. Remove setting knob and instrument cover; See Figure 17.
4. Using  $\frac{5}{16}$ " wrench, turn the zero adjustment "C" accordingly until black indicating pointer reading agrees with test thermometer reading or known temperature. Turning in lowers indicated reading.
5. Check adjustment by allowing temperature to stabilize and comparing readings. Repeat above steps if necessary.
6. Replace instrument cover and knob.

### Adjusting Single Switch Types (BCT-800 and 820E)

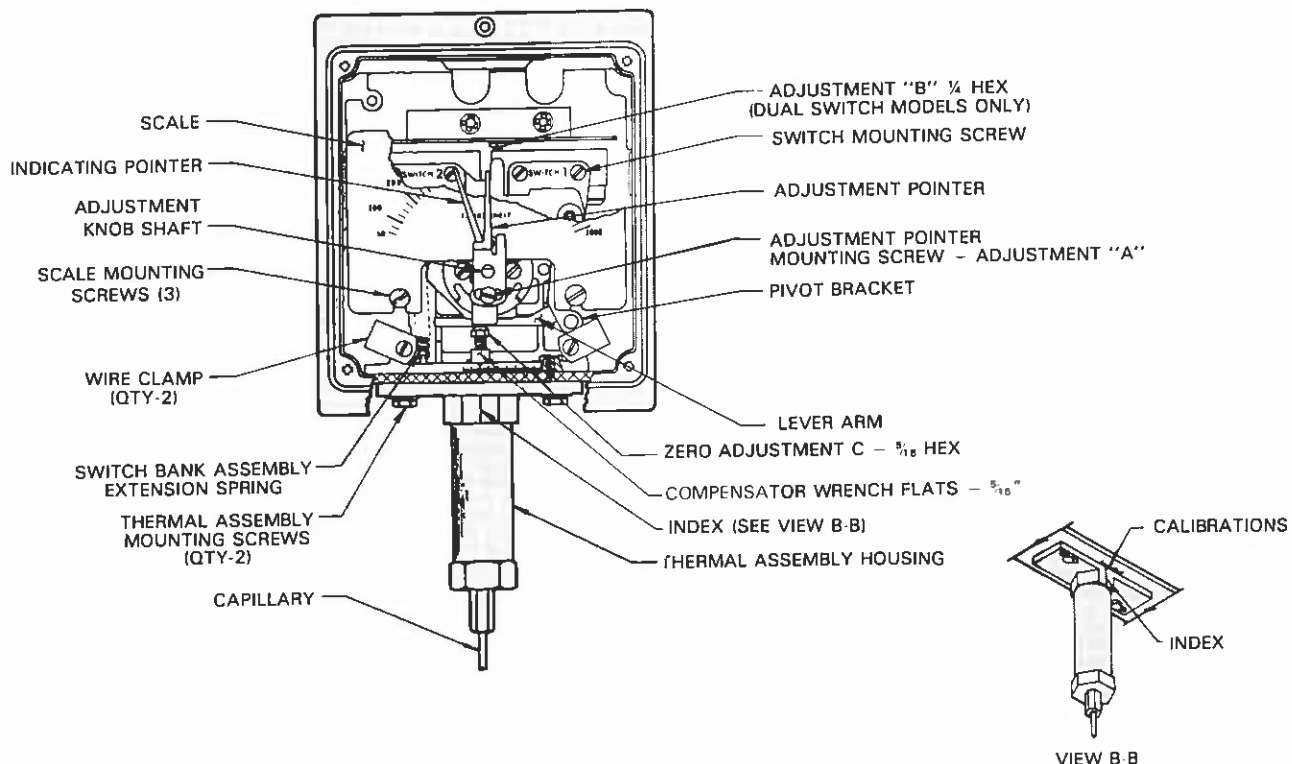
1. Remove knob and instrument cover.
2. Move the adjustment pointer up scale beyond the indicating pointer. This permits checking the set point by moving the lever

arm upward with a finger or tool simulating thermal assembly movement.

3. Connect test lights to indicate switch operation or listen for the switch "click".
4. Loosen adjustment "A" (Figure 17) until the adjustment pointer agrees with the indicating pointer (when the switch "clicks").
5. Replace instrument cover and knob.

**NOTE:** Indicating pointer deflection — The indicating pointer will read slightly low at bulb temperatures above the controller setting. This deflection is normal and repeatable (approximately .5% of scale range for single switch models) and is due to the transference of the switching mechanism load to the thermal system. It can be measured by moving the setting pointer from the high to the low end of the scale and observing the resultant indicating pointer deflection.

**NOTE:** DUAL SWITCH VERSION IS SHOWN. IN SINGLE SWITCH VERSION, ONLY ONE SNAP-ACTING SWITCH IS USED.



GENERAL LAYOUT (LEADWIRES OMITTED FOR CLARITY)

Figure 17

## CALIBRATION (continued)

### Adjusting Dual Switch Type BCT-802

1. Connect test lights to indicate switch operation or listen for the individual switch "clicks".
2. The separation between switches is the difference between the high and low set points. The set points are determined by setting individual adjustment pointers and may be separated up to 100% of the scale range apart.
3. To align either switch to the adjustment pointer the corresponding adjustment "A" must be loosened and set the adjustment pointer to the indicator pointer.

**NOTE:** Switch #1 cannot be set to operate at a higher setting than switch #2. *green*

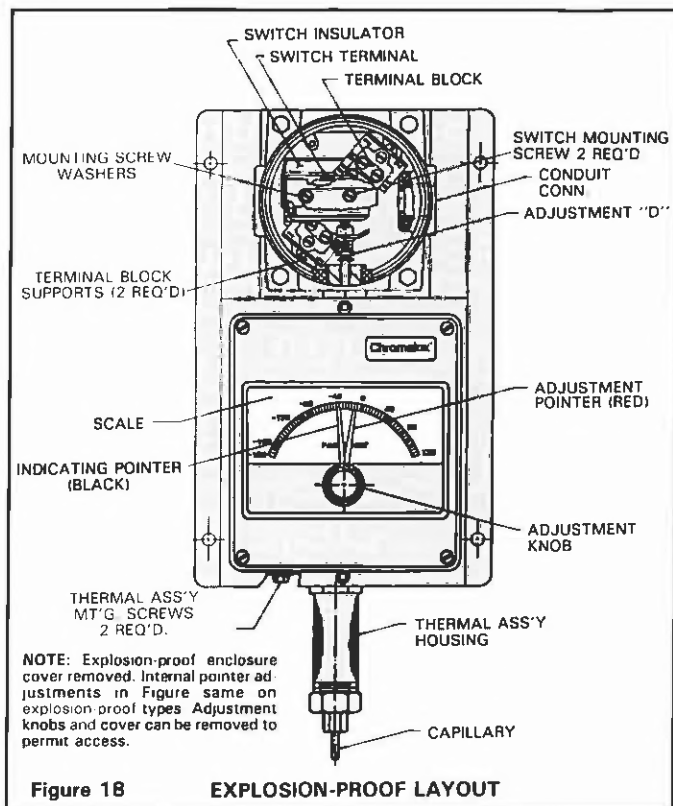
### Adjusting Dual Switch Explosion-Proof Type BCT-822E

1. Remove the explosion-proof die-cast cover to permit access to the switches.
2. Move the adjustment pointer up scale beyond the desired difference between the switch settings. This permits checking the settings by moving the actuating lever upward with a finger or tool simulating thermal assembly movement.
3. Connect test lights to indicate switch operation or listen for the individual switch "clicks". *red*
4. The set point of switch #1 is determined by the red adjustment pointer. The set point of switch #2 may be adjusted by up to 50% of the range span below the switch #1 set point by turning adjustment "D" in (right hand thread). See Figure 18. The set point of switch #2 should not be above that of switch #1.
5. To align switch #1 to the adjustment pointer, loosen adjustment "A" and set the adjustment pointer to the scale. *green*

### Correction for Capillary Immersion

If the length of capillary immersed in the process differs from the amount immersed in the factory calibration bath, a calibration shift will occur. The error may be corrected as follows:

1. Move set pointer to highest temperature setting.
2. Note indicating scale reading with the head and sensor at room temperature.
3. Loosen the two thermal assembly mounting screws.
4. Reposition the housing index against the calibration on the instrument case (or skeleton casting) at a rate of 1 division line per capillary length listed in table. Move to the left if capillary is to be added to the process, or to the right if capillary is removed from the process.
5. Tighten the two thermal assembly mounting screws.



6. Note change in indicated scale reading (if any).
7. Turn zero adjustment "C" to bring indicating pointer reading back to the original reading noted in RE-ZEROING. Turning in lowers indicated reading.

**NOTE:** Thermal assembly can be returned to its original position by aligning its flange with the line scribed on the instrument case.

Model No.	Range	Capillary Length/Division*
4	- 40 to 120°F	4 Ft.
6	0 to 250°F	2 ½ Ft.
7	0 to 400°F	2 Ft.
8	50 to 650°F	2 Ft.
9	50 to 1000°F	2 ½ Ft.

## OPERATION

**CAUTION:** Do not exceed maximum temperature indicated on the scale as physical damage to the control mechanism may result.

### PRE-START-UP

The control should be checked against a test thermometer of known accuracy before being put into service. As with any precision instrument, minor adjustments may be necessary after shipment and installation. See Calibration.

**After installation and wiring, to check the operation of heating systems:**

1. Disconnect power.
2. Place the heat/cool selector switch, if applicable, in the heat position. (Figures 13 and 14)
3. Adjust the setpoint ten or more degrees below the temperature of the controlled space.

4. Restore power.
5. Slowly adjust the setpoint upward. When the setpoint reaches the approximate temperature of the controlled space, the heating equipment should start.

**To check the operation of the cooling systems:**

1. Disconnect power.
2. Place the heat/cool selector switch, if applicable, in the cool position. (Figures 13 and 14)
3. Adjust the setpoint ten or more degrees above the temperature of the controlled space.
4. Restore power.
5. Slowly adjust the setpoint downward. When the setpoint approximates the temperature of the controlled space, the cooling equipment should start.

## ELEMENT AND SWITCH REPLACEMENT

**CAUTION:** Disconnect all power before servicing this control. Failure to comply can result in electrical shock or electrocution.

Components most likely to require replacement are the thermal assembly and the switches. Replace as follows:

### Thermal Assembly Replacement

1. Thermal assemblies are "pre-calibrated" at the factory and can easily be interchanged with the old one. Instructions are included with each replacement assembly. See re-zeroing under Calibration, Page No. 6.
2. Should the thermal assembly be removed temporarily for any reason, it should be replaced so that the edge of its flange corresponds with the line scribed on the instrument case.

## ELEMENT AND SWITCH REPLACEMENT (continued)

### Replacement of Switches

(The leadwire's configuration, though rather slack from the switch bank assembly to the wire clamp, is necessary for proper controller operation. This configuration should be duplicated when replacing a switch).

1. Turn the adjustments to the upper range limit. This will permit access to all (3) scale mounting screws.
2. Remove the scale and unscrew the screw holding pivot post mounting bracket. Be sure to save the (2) spacers under the bracket. (Dual switch types only).
3. Remove the tension spring from switch bank assembly.
4. The switch bank assembly can now be removed from the pivot post.

### Dual Switch Types

- A. Disassemble switch #1 extension spring. This will permit access to whatever switch needs replacement.
- B. Insert new switches and leadwires on switch bank assemblies.
- C. Re-assemble switch #1 extension spring and re-install entire assembly onto pivot post.

### Single Switch Types

- A. Remove the cover from the switch.
  - B. Insert new switches and leadwires on switch bank assemblies.
  - C. Re-assemble switch assembly to pivot post.
5. Re-assemble switch bank assembly tension spring.
  6. Install the (2) spacers and secure the pivot post mounting bracket.

7. Replace the scale, making sure the scale mounting holes are properly fitted around the cast-in guides hidden by the screws.

8. Re-calibrate the set points following the procedures in Calibration Section Page No. 6.

### Replacement of Switches (Explosion-Proof Types)

#### Single Switch Type

1. Remove die-cast aluminum cover and disconnect (3) wires at switch terminals.
2. Remove (2) switch mounting screws, the switch and the insulator.
3. Install insulator with new switch and mount in control.
4. Connect wires at switch terminals and adjust temperature setting per wiring diagram Figures 9 thru 14.

#### Dual Switch Type

1. Remove die-cast aluminum cover, unscrew and remove terminal block and insulator, letting terminal block hand.
2. Unscrew terminal block supports and remove (2) switch mounting screws, washers and wire guard.
3. Lift out dual switch bank and actuating lever assembly.
4. Disconnect (6) wires at switch terminals.
5. Assemble new switches and insulators to the switch bank assembly.
6. Connect wires at the switch terminals.
7. Install switch bank assembly, terminal block supports, insulators, wire guard and terminal block in controller.
8. Adjust temperature setting.

## RENEWAL PARTS IDENTIFICATION

Temperature Range °F/°C	Thermal Element			Dial Scale
	Cap Length	Material	Part No.	
- 40 to 120°/- 40 to 50°	6	Copper	300-056700-004	169-512875-004
	6	Stainless	300-056700-006	
0 to 250°/- 20 to 120°	6	Copper	300-056700-008	169-512875-006
	6	Stainless	300-056700-010	
	10	Teflon Covered SS	300-056700-001	
0 to 400°/- 20 to 200°	6	Stainless	300-056700-012	169-512875-007
50 to 650°/10 to 340°	6	Stainless	300-056700-014	169-512875-008
50 to 1000°/10 to 540°	6	Stainless	300-056700-016	169-512875-009

Catalog No.	Switch	Knob	Cover Assembly
BCT-800	292-512876-001	169-512875-010	080-512877-001
BCT-802	292-512876-001	169-512875-011	080-512877-002
BCT-820E & 822E	292-512876-002	169-512875-013	080-512877-003

**The warranty below has been drafted to comply with the new Federal Law applicable to products manufactured after December 31, 1976. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state. The warranty in no manner reduces the coverage provided to you under the warranty it replaces.**

**Chromalox Warranty:** Chromalox industrial products are warranted against defects in workmanship and materials. NO OTHER WARRANTIES, WRITTEN OR ORAL, INCLUDING, BUT NOT LIMITED TO, WARRANTIES OF MERCHANTABILITY AND WARRANTIES FOR A PARTICULAR PURPOSE, APPLY. No person is authorized to give any other warranty or assume any other liability except by written statement from an officer of the Edwin L. Wiegand Division, Emerson Electric Co.

**Warranty Period:** This warranty extends for twelve months from date of shipment from factory or authorized distributor.

**Limitations:** Products must be installed and maintained in accordance with Chromalox in-

structions. Users are responsible for the suitability of the products to their application. There is no warranty against damage resulting from corrosion, misapplication, improper specification or other operating conditions beyond our control. Claims against carriers for damage in transit must be filed by the buyer.

**Remedy:** Return the defective part or product, freight prepaid, to the location designated by Chromalox Product Service. All such items must be accompanied by a Material Return Authorization. This form, which includes a tear-out mailing and identification label, should be obtained from your local Chromalox Sales Office.

Defective items will be repaired or replaced at our option. SUCH REPAIR OR REPLACEMENT IS THE EXCLUSIVE REMEDY AVAILABLE FROM EDWIN L. WIEGAND DIVISION, EMERSON ELECTRIC CO. WIEGAND IS NOT LIABLE FOR LABOR COSTS INCURRED IN REMOVAL, REINSTALLATION, OR UNAUTHORIZED REPAIR OF THE PRODUCT OR FOR DAMAGE OF ANY TYPE WHATSOEVER, INCLUDING INCIDENTAL OR CONSEQUENTIAL DAMAGE. Some states do not allow the exclusion or limitations of incidental or consequential damages, so the preceding limitation or exclusion may not apply to you.

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